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LAMINATING METHOD FOR DECORATIVE SYNTHETIC RESIN SHEET
[GOSEIJUSHI SEI KESHO SHIITO NO RAMINEETO HOHO]

TAKASHI KAWASHIMA

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INVENTOR(S)	(72):	Takashi Kawashima
APPLICANT(S)	(71):	Tateyama Aluminium Inc.
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Specification

1. Title of the Invention

Laminating method for decorative synthetic resin sheet

2. What is claimed is:

A laminating method for a decorative synthetic resin sheet, characterized in that fine pores having a pore size of 0.01 to 0.1 mm are pierced through a decorative synthetic resin sheet in advance at a distribution density of 10 to 1,000 holes per 1 cm^2 of the sheet and the resulting decorative synthetic resin sheet is adhered to the outer surface of a substrate via an adhesive agent.

3. Detailed Description of the Invention

The present invention relates to a method for laminating a decorative sheet constituted of a synthetic resin, such as polyvinyl chloride, onto the outer surface of aluminum extruded-profiles and various other materials, such as steel materials and plastic materials.

In general, aluminum and materials, such as steels and plastics, are often used straightforwardly or with various treatments, such as anodic oxidation, coloring and coating. However, in recent times, the focus has been placed on products laminated with a decorate sheet constituted of a synthetic resin, such as polyvinyl chloride, on which wood

grain patterns and various other patterns and colors have been printed in order to improve the aesthetic quality of these materials, and a variety of lamination machines have also been developed according to the type and shape of the substrates.

For example, in the case where a decorative sheet constituted of polyvinyl chloride is laminated onto an aluminum extruded-profile, an adhesive agent is applied to the back surface of the decorative sheet by a knife-coating method, the resulting decorative sheet is passed through an hot-air furnace in order to volatilize the solvent contained in the adhesive agent, and the resulting decorative sheet is stepwisely adhered to the outer surface of the aluminum extruded-profile as a substrate while the decorative sheet is partly pressed by compressive rolls.

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In this case, although depending on the type of the adhesive agent, since the decorative sheet to be adhered to the substrate is usually laminated while it is semi-dried, the amount of the solvent contained in the adhesive agent layer at the point of lamination significantly affects the finished appearance and the adhesion force. More specifically, if the solvent residue in the adhesive agent layer is small, the initial adhesion force between the

aluminum extruded-profile and the adhesive agent will become small; therefore, spaces which have not completely been laminated can be generated particularly in the extruded profiles having a complicated shape. If the solvent residue is large, the curing of the adhesive agent will become slow, resulting in spaces being readily generated in the concave portion and fine air bubbles of the solvents which have been trapped can be readily generated in the flat portion, resulting in many blisters being generated on the surface of the decorative sheet, which is not preferred in terms of the appearance.

General thermoplastic-resin adhesive agents (e.g., adhesive agents based on epoxy resins, polyurethane resins, polyester resins, melamine resins or urea resins) have been widely used as an adhesive agent for this application and can be applied at a thickness on the wet basis of 20 to 200 μm by a conventional knife-coating method while approximately 40 to 80% of the application amount accounts for a solvent. For this reason, in order to adjust the amount of the solvent in the adhesive agent layer during lamination to an adequate amount, the solvent is volatilized by blowing hot air at a temperature of 30 to 50 degrees Celsius by passing the applied adhesive agent through a hot-air furnace. However, in practice, since the

result significantly depends on the variation of the applied account, the lamination rate, air temperature and humidity, even if the conditions in the hot-air furnace, it is significantly difficult for the amount of the solvent in the adhesive agent layer to be held constant.

The present inventor conducted intensive research on this point over a long time and discovered: that the modification of the application process for an adhesive agent to a decorative sheet, the drying process and the following process for compressing the sheet to a substrate using rolls were limited even under the strictest conditions and would not solve the problems; rather that the problems resulted in the fact that decorative sheets constituted of synthetic resins, such as polyvinyl chloride, had poor air-permeability, interrupting the smooth volatilization of the solvent contained in the adhesive agent applied to the back surface of the decorative sheet and the smooth deaeration of air bubbles; and that, if excellent air-permeability could be provided with the decorative sheet without impairing the aesthetic quality by any means whatsoever, an appropriate laminate process could be conducted on the decorative sheet without any special modifications to the application or drying processes for

the adhesive agent and the process for compressing the decorative sheet to a substrate.

The inventive laminating method for a decorative sheet was developed based on the above-described novel idea and is characterized in that fine pores having a pore size of 0.01 to 0.1 mm are pierced through a decorative synthetic resin sheet in advance at a distribution density of 10 to 1,000 holes per 1 cm^2 of the sheet and the resulting decorative synthetic resin sheet is adhered to the outer surface of a substrate via an adhesive agent.

An embodiment according to the present invention is described with reference to diagrams, with Fig. 1 being a front view illustrating the structure of a lamination machine (M) used in the present embodiment and its operation procedures, Fig. 2 being a cross-sectional view illustrating an aluminum extruded-profile (F) to which an decorative sheet (S) has been applied according to the present invention, and Fig. 3 being an enlarged perspective view of the principal part illustrating the adhesive state between the extruded profile (F) as a substrate and the decorative sheet (S). The present embodiment used an automatic profile laminating machine RKM400, manufactured by FRY, West Germany, as a processing machine, a decorative sheet obtained by printing a wood grain pattern of Akita

sugi (Cryptomeria japonica) on a polyvinyl chloride sheet having a width of 150 mm and a thickness of 0.16 mm as the decorative synthetic resin sheet (S), and an aluminum extruded-profile that had a cross-sectional shape as shown in Fig. 2, had a length of 4,000 mm and had been treated with anodic oxidation coating at a thickness of 6 mm as the substrate (F). The lamination processes are mechanically and continuously conducted in the sequence described below.

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More specifically, a long decorative sheet (S) that has been rolled up is installed in the feed part and is pulled out in the direction shown by the arrow at a specific rate, to then be inserted between needle rolls (1) (1) [sic] on which many needles have been implanted, wherein fine pores (H) having a pore size of 0.01 mm are uniformly pierced through the decorative sheet (S) at a distribution density of 25 holes per 1 cm^2 of the sheet. In this event, the pore size of the fine pores (H) is preferably in a range of 0.01 to 0.1 mm; if the diameter of the pores is less than 0.01 mm, a sufficient air-permeability may not be obtained, whereas if the diameter of the pores is over 0.1 mm, the appearance of the pores may become clear, resulting in the aesthetic quality being impaired, and the adhesive agent (2) may come out when the

adhesive agent (2) is applied to the back surface of the decorative sheet (S) in the following process. If the distribution density of the fine pores (H) is 10 or more per 1 cm^2 of the sheet, a sufficient air-permeability can be obtained, whereas if the distribution density is 1,000 or more, the processability may become significantly impaired. The use of needle roll (1) is the simplest means of piercing and is most processable, and if the tip of the needle is formed into a conical shape, the size of the fine pores (H) can be desirably controlled by simply adjusting the compressive force of the needle roll (1) to the decorative sheet (S). The piercing process for creating the fine pores (H) can also be conducted before or after the process for printing a surface pattern on the decorative sheet (S).

Next, the decorative sheet (S) is introduced into the adhesive agent applying device (3) using a knife coater, wherein a mixture of 100 parts of BondMaster RL906, tradename, (base component), 65% solvent, 5 parts of RL287-6948 (curing agent) is uniformly applied, as an adhesive agent (2), to the decorative sheet (S) at a thickness of approximately 100 μm, and the resulting decorative sheet (S) is fed to the hot-air furnace (4) and is heated at a furnace temperature of 40 degrees Celsius, at a passing

rate of 20 m/min., at a temperature of 25 degrees Celsius and at a humidity of 76% in order to adequately volatilize the solvent contained in the adhesive agent layer.

The surface with the adhesive agent of the resulting decorative sheet (S) is reversed via guide rolls (5) and (6) and guided to the underside of the compressive rolls (7) as shown by an arrow in the diagram, wherein the decorative sheet (S) is assembled with an extruded profile (F) which is conveyed by feed rolls (8) arranged thereunder, is laminated onto the outer surface of the extruded profile (F) by the continuous and stepwise compression by the compressive rolls (7), and the laminated article is discharged from the device by the discharge rolls (9).

The resulting extruded profile (F) laminated by the decorative sheet (S) allows the volatilization of the adhesive agent (2) to be significantly and appropriately conducted thanks to the presence of the fine pores (H) provided on the decorative sheet (S), and since the air bubbles in the decorative sheet can be reliably removed through the deaerating effect of the fine pores (H) during compressing of the decorative sheet, the generation of popping (S1) and blisters (S2) on a decorative sheet (S)' on an extruded-profile (F)' as shown in Fig. 4 processed by a conventional lamination method can be prevented and a

product having an attractive appearance can be therefore obtained.

In order to confirm the above-described fact, the application amount of the adhesive agent (2) was adjusted to 4 types, 60 μm, 100 μm, 140 μm and 180 μm, by controlling the clearance of the knife coater, and the decorative sheet (S) having fine pores (H) according to the present embodiment and the decorative sheet (S)' without fine pores (H) were respectively laminated onto extruded profiles (F) and (F)', and the results are shown in Table 1.

Table 1

Application amount of adhesive agent	Embodiment		Comparative Example	
	Concave portion	Flat portion	Concave portion	Flat portion
60 μm	No abnormality	No abnormality	Popping on vinyl chloride sheet	3 blisters
100 μm	No abnormality	No abnormality	Popping on vinyl chloride sheet	16 blisters
140 μm	No abnormality	No abnormality	Popping on vinyl chloride sheet	30 blisters
180 μm	No abnormality	No abnormality	Popping on vinyl chloride sheet	35 blisters

As is clear from the results shown in the above Table, popping (S1) was generated in the concave portion (F1) of the decorative sheet and blisters (S2) were created in the flat portion (F2) of the decorative sheet while the present embodiment had no problems with the appearance, and it is confirmed that the tendency for the generation of blisters

increases as the application amount of the adhesive agent (2), i.e., the absolute quantity of the solvent, increases.

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4. Brief Description of the Drawings

Fig. 1 is a front view illustrating the structure of a lamination machine used in the present embodiment and its operation procedures, Fig. 2 is a cross-sectional view illustrating an aluminum extruded-profile to which an decorative sheet has been applied according to the present invention, Fig. 3 is an enlarged perspective view of the principal part illustrating the adhesive state between the extruded-profile as a substrate and the decorative sheet, and Fig. 4 is a cross-sectional view illustrating an extruded-profile on which a decorative sheet has been laminated by a conventional method.

(S)(S)': decorative sheet, (F)(F)': aluminum extruded-profile, (F1): concave portion, (F2): flat portion, (S1): decorative sheet, (S2): blisters on decorative sheet, (1):needle roll, (2): adhesive agent, (H): fine pore, (3): adhesive agent applying device, (4): air-heating furnace, (5)(6): guide rolls, (7): compression roll, (8): feed roll, (9): discharge roll

Fig. 1

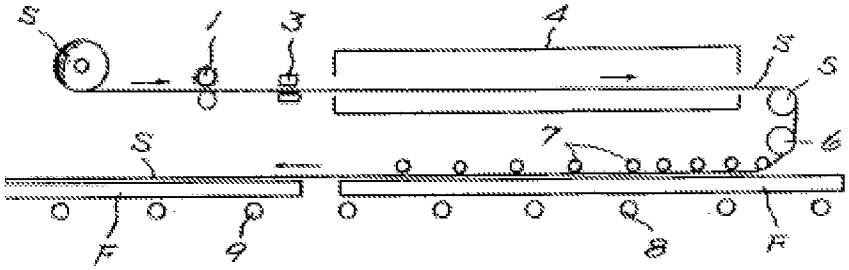

Fig. 2

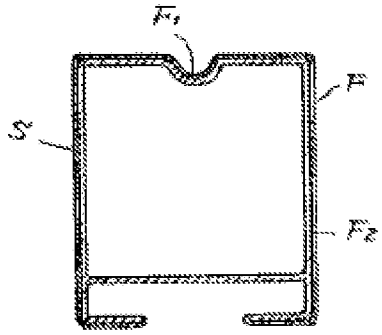

Fig. 3

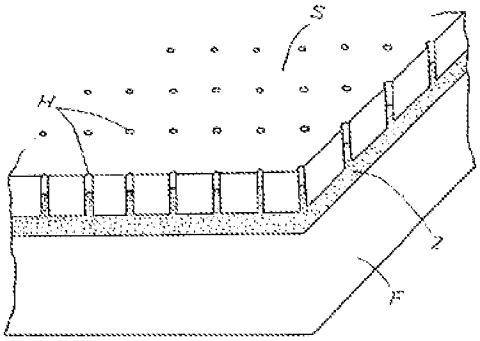

Fig. 4